Synthetic Auxin Resistance in Corn Poppy

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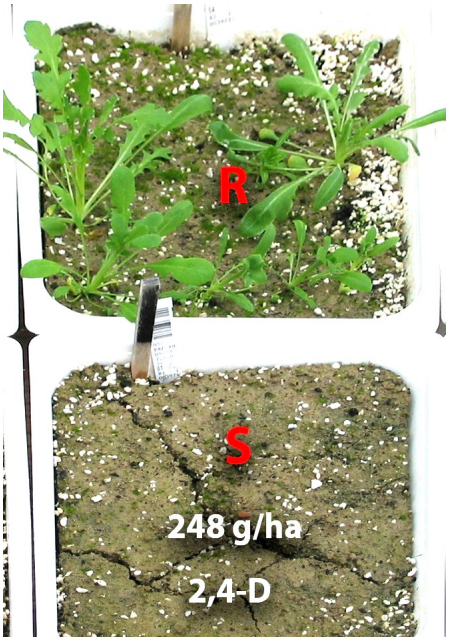
HERBICIDE RESISTANCE ACTION COMMITTEE

Synthetic Auxin Resistant Corn Poppy

Corn poppy is the most important broadleaf weed of winter wheat in southern Europe. Synthetic auxins, particularly 2,4-D, have been used to control corn poppy in winter wheat for over 60 years. Synthetic auxin resistant corn poppy was first identified in Spain in 1993, and subsequently in Italy and France. Synthetic auxin resistance in corn poppy is now widespread in both of these countries.

Levels of Resistance and Cross-Resistance

Levels of resistance to 2,4-D in corn poppy is relatively low at around 4 fold. The recommended rate of 2,4-D in wheat can provide up to 75% suppression of resistant corn poppy biomass.



Synthetic auxin resistant and susceptible corn poppy after treatment with 2,4-D. Photo: Dr. Laura Scarabel

Mechanism of Resistance

Synthetic auxin resistance in corn poppy is thought to be due to metabolism however further research is required for verification.

Rate of Spread

Synthetic auxin resistance in corn poppy is widespread in Spain and Italy. A survey published in 2001 of 134 populations indicated that 85% of the corn poppy populations had synthetic auxin resistance and 72% had ALS inhibitor resistance in Spain.

Resistance to Other MOA's

In addition to synthetic auxin resistance, corn poppy has evolved resistance to ALS. The first case of ALS inhibitor resistance in corn poppy was reported in 1993 in Spain. Belgium, Denmark, France, Germany, Greece, Italy, Poland, Spain, Sweden, and the United Kingdom have all reported acetolactate synthase (ALS) inhibitor. resistant corn poppy. Corn poppy has shown resistance to most ALS inhibitor herbicides used for corn poppy control. Seven mutant ALS alleles, Ala197, Arg197, His197, Leu197, Ser197, Thr197 and Leu574 that have been identified that confer ALS inhibitor resistance in corn poppy populations. Combinations of these mutant ALS alleles have sometimes been found in the same population, and indeed in the same plant. The different mutant ALS alleles give different patterns of cross resistance to ALS inhibitors however all appear to confer resistance to sulfonylureas such as tribenuron. These mutations are dominant and spread rapidly throughout fields through pollen and seed dispersal.

Multiple Resistance

Multiple resistance (to synthetic auxins and ALS inhibitors) was identified in 58% of corn poppy populations collected in a field survey from Northern Spain in 2001.

Best Management Practices

Integrated weed management including herbicide rotation, mixtures, and cultural/ mechanical controls should be practiced to delay the selection of synthetic auxin resistant corn poppy. Individual corn poppy plants are not very competitive with cereals, however corn poppy reduces crop yield when present at high densities. Prior to the introduction of modern herbicides corn poppy was kept in check by tillage, crop rotation, stale seedbed and fallow.

Corn poppy seed heads

Additional information on herbicide resistance can be found at weedscience.org

These non-herbicidal control measures, when used in combination with herbicide rotation, can be valuable tools reduce population levels and delay the evolution of resistance. Annual shallow tillage in combination with occasional deep ploughing does reduce population numbers but will not eliminate corn poppy. Unfortunately poppy seed banks decline very slowly. Models predict that the optimum management of corn poppy today would include 7 years of zero tillage, 2 years of minimum tillage, and one year of moldboard ploughing.

The fact sheet “Synthetic Auxin Resistant Weeds” provides more detail on how to delay and mitigate resistance.

Facts about Corn Poppy

SCIENTIFIC NAME

Papaver rhoeas

OTHER COMMON NAMES

blindy-buffs, bledewort, canker rose, cheesebowl, cockrose, copper-rose, corn rose, field poppy, redweed, soldiers, thunder flower

SEED LONGEVITY AND EMERGENCE

Corn poppy has a very long soil seed life. Typically populations decline to low levels after 10 years of prevention of seed set in a cropping system, and up to 20 years in undisturbed soil.

High Level of Genetic Variability

Corn poppy is insect-pollinated and self incompatible leading to a high level of genetic variability as evidenced by the numerous forms in leaf shape and hairiness, as well as a high ratio of albino and tricotyledonous forms (1 in 4000). This high level of genetic diversity makes corn poppy prone to evolving herbicide resistance.

Seed Production and Dispersal

Without competition corn poppy plants can produce more than 530,000 seeds, however under competition from cereals they produce between 6,000 and 41,000 seeds. The seeds have a high level of dormancy when shed, and require more than 12 weeks burial prior to germination. Seeds are very small and are easily dispersed in soil on farm equipment.

Corn poppy seeds

Herbicide Options

There are a number of alternative herbicide mechanisms of action to use on synthetic auxin resistant corn poppy. Trifluralin, linuron, and pendimethalin provide adequate pre-emergence control, and bromoxynil, ioxynil, befubutamid, and isoproturon can be used for post-emergence control. In addition there are a number of ALS inhibitors that could provide control of the synthetic auxin resistant corn poppy as long as the particular population doesn’t also have resistance to ALS inhibitors. Rotation and mixtures of herbicide mechanisms of action is the best defense against resistance.

REFERENCES

Torra, J., Cirujeda, A, Recasens, J., Taberner, A. and S. B. Powles. 2010. PIM (Poppy Integrated Management): a bio-economic decision support model for the management of *Papaver rhoeas in* rain-fed cropping systems. *Weed Research* 50, 127–139.

Cirujeda, A. 2001. Integrated Management of Herbicide Resistant *Papaver rhoeas* L. Populations. PhD thesis. Universitat de Lleida, Lleida, Spain.

Délye C., Pernina F., L. Scarabel. 2011. Evolution and diversity of the mechanisms endowing resistance to herbicides inhibiting acetolactate-synthase (ALS) in corn poppy (*Papaver rhoeas* L.). *Plant Science* 180 333–342.

Torra, J., Cirujeda, A, Taberner, A., and J. Recasens. 2010. Evaluation of herbicides to manage herbicide-resistant corn poppy (*Papaver rhoeas*) in winter cereals. *Crop Protection* 29 731 -736.